BIOLOGY OF THE TWO-LINED SPITTLEBUG, *PROSAPIA BICINCTA*, ON FLORIDA PASTURES (HOMOPTERA: CERCOPIDAE)[1]

E. BRAD FAGAN AND L. C. KUITERT[2]
Department of Entomology and Nematology,
University of Florida, Gainesville

ABSTRACT

Biological studies on the two-lined spittlebug, *Prosapia bicincta* (Say), were conducted at 3 locations in Florida. It overwinters in the egg stage. Eggs hatched in 19 days under optimum conditions. There were 5 nymphal instars and the nymphal period averaged 50 days. The life cycle was about 76 days from egg to egg. Nymphs were recorded on 40 plants, predominantly grasses.

Transformation to adult took place within the spittlemass formed at the last feeding site of the 5th instar nymph. Females evidently mate before and after oviposition. Virgin females 2-6 days old gave off a perfume-like odor. Caged females began ovipositing when 7 days old and averaged 50.3 eggs. Two parasites and 4 predators were recorded on the adults.

In light trap studies, about 85% of the adults were captured within 4 hr after sunset. There were 2 peaks of seasonal abundance in light traps, one in June and another in August to early September. Catches averaged 96% males.

Adults, rather than nymphs, apparently cause the visible damage to the grass. Single adults caged on individual stems of pangolagrass killed the blades in 1-3 days and the stems in 3-4 days.

The two-lined spittlebug, *Prosapia bicincta* (Say), is the single representative of the genus in North America. The adults are easily recognized by size and coloration. They are about 1 cm long and dark brown to black dorsally with 2 reddish orange transverse bands on the wings. The literature prior to 1963 is mostly taxonomic and contains few references to biology. This species was first recognized as a pest in Florida on pangolagrass and St. Augustinegrass (Genung et al. 1954). It has since become one of the most important pests on improved pasture grasses throughout the Southeast.

Beck (1963) and Byers (1965) discussed the biology and control of *P. bicincta* on Coastal bermudagrass in Georgia. Pass and Reed (1965) conducted a similar study in South Carolina. The present investigation was initiated because little information was available on the biology or bionomics on pasture grasses under Florida conditions. The results of studies conducted from September 1966 to November 1968 are reported here.

METHODS

REARING:—Eggs were collected for laboratory work following the methods developed by Beck (1963) and Byers (1965). Eggs were placed in 9 cm petri dishes on filter paper, then kept continually moist under greenhouse conditions until hatching.

---

[1] Florida Agricultural Experiment Stations Journal Series No. 3260.
[2] Graduate Research Assistant and Entomologist respectively.

Nymphal studies were conducted in the field and greenhouse. Nymphs were reared using the method described by Byers and Wells (1966). In determining the nymphal instars, head capsules were measured across the outer margins of the eyes and the mesothoracic wing pads were measured from the posterior edge of the pronotum to the posterior tip of the pads.

LIGHT TRAPPING:—Light traps used in determining the seasonal occurrence were of the type described by Hollingsworth et al. (1963). They were omnidirectional in coverage and used 15-w blacklight lamps. Traps were placed on stands with the light source centered 48 inches above the ground. The spittlebugs were trapped and preserved in 70% isopropyl alcohol.

To determine the periods of adult activity at night, a light trap which divided the catch into hourly samples was utilized. It was a slight modification of a design by King et al. (1965).

NATURE OF INJURY TO PANGOLAGRASS:—Individual adults were confined about 6 inches above the soil on stems of potted pangolagrass in the seed-head stage. This was replicated 12 times. Visual observations on the progression of symptoms were recorded. Maerz and Paul (1930) color charts were used to determine the colors in describing the symptoms.

RESULTS

EGG STAGE:—*P. bicincta* overwinters in the egg stage in Florida with only an occasional adult recorded in the winter in the Belle Glade area. Eggs are deposited at the base of grass in moist litter and debris. Occasionally they are inserted between the leaf sheath and stem or into the stem of the grass. The base of the grass, rather than the runners or matted top growth, is the favored oviposition site. The eggs are produced singly but many eggs may be found in one location.

Fifty eggs averaged 1.02 mm in length (range .96 mm to 1.06 mm) and .35 mm in width (range .32 mm to .37 mm). New eggs are bright yellow and more pointed at the anterior than at the posterior end. There is no evidence of a micropyle in the egg chorion. As the egg matures, a dark longitudinal streak develops from the anterior tip to about the middle of the egg. The area gradually darkens for 5 to 6 days, then a black "hatching lid" splits the chorion and protrudes until the egg hatches. Eggs 12-15 days old have a red spot on each side of the "hatching lid" and also on each side of the posterior end. These red areas later coincide with the red eyes and the 2 red areas on the abdomen of the nymph. Eggs held at 22.2-24.4°C on moist filter paper hatched in 16-21 days (mean of 19 days). At hatching, the black lid breaks away and the nymph emerges head first and ventral side uppermost. Most eggs hatched at night.

Eggs were obtained from field collected females from June through October. Eggs collected in September and October failed to hatch and were considered in diapause. This suggests that eggs oviposted by fall females enter diapause regardless of environmental conditions in the field.

NYMPHAL STAGE:—Upon hatching, the 1st instar nymph seeks a suitable feeding site. It probes in several spots before the mouth parts are finally inserted and a spittlemass is produced. The nymphs are not confined to one site and move about, especially after molting. Their movements should render them susceptible to residual insecticides.

One to 6 nymphs, sometimes in different instars, have been observed in a single spittlemass. The 3rd instar produces an easily visible spittlemass and is commonly the first one observed in the field. During wet periods nymphs crawl up stems, produce spittlemasses, and remain until surface water recedes. Stems and runners of grass at ground level are favored feeding sites of the nymphs.

Nymphs were recorded on 40 plants (Table 1). These were predominantly grasses on which the adults also commonly feed.

Molts between instars take place within the spittlemass. Byers (1965) and Washbon (1968) found 4 nymphal instars while Pass and Reed (1965) recorded 5. A perusal of the literature indicates that 5 instars are the rule for cercopids. There were 5 instars recognized in this study based on the number of molts observed during rearing and on measurements of the head capsules and mesothoracic wing pads of both reared and field collected nymphs. Body length was found to be a poor indicator of instars. Measurements from 150 nymphs are summarized in Table 2.

Two-lined spittlebug nymphs were difficult to rear, especially through the early instars. Nymphs reared in the greenhouse in July averaged 8 days for the 1st instar, 8 days-2nd, 10 days-3rd, 12 days-4th, and 12 days for the 5th instar. The nymphal stage averaged 50 days.

The 5th instar changes in appearance about 24 hr before the final molt as the reddish bands of the adult become visible through the nymphal exoskeleton. Transformation to the adult takes place within the spittlemass formed at the last feeding site of the 5th instar nymph. The nymph often crawls several inches up a stem and feeds long enough to form a spittlemass. Ball (1928) first described the manner in which molting is accomplished; i.e., the nymphal skin splits over the top of the head and thorax and the adult crawls out.

ADULT STAGE:—Most adults emerge in the early morning, rest inside the spittlemass until the wings harden, and depart before noon. The teneral adults are white except for the red bands on the wings and pronotum. They attain the mature coloration within hours.

Adults readily mated in cages. In the field, mating usually was observed in the grass near the ground. Mating was observed throughout the day and growing season. Some females of mating pairs captured in the field contained developed eggs, others did not. This indicates that females mate both before and after oviposition begins.

Caged virgin females, 2-6 days old, gave off a perfume-like odor. The odor was easily detectable and especially strong in the mornings. The nature or function of this odor was not ascertained.

Caged females began ovipositing when 7 days old and the average oviposition period was 14 days. Females laid from 0-142 eggs with the average being 50.3. Of 349 eggs collected in July, 94% were viable. Caged females in the greenhouse lived an average of 21 days. Eggs are deposited in the field throughout the growing season.

PARASITES AND PREDATORS:—No parasites or predators of the eggs and nymphs were found or have been recorded for *P. bicincta*.

A parasitic fungus, *Entomophthora grylli* Fresenius,[3] attacks the adults, especially in September. Large numbers of parasitized adults were ob-

[3] Identified by L. R. Batra, Crops Production Research Branch, USDA, ARS, Beltsville, Md.

TABLE 1. HOST LIST OF *Prosapia bicincta* NYMPHS IN FLORIDA.

Numbers following common names refer to citation in this list.

1. Personal observation
2. Genung and Allen, 1962
3. Genung et al., 1954
4. Maines, 1954
5. Mead, 1962
6. Washbon, 1968

Scientific Name	Common Name
Andropogon capillipes Nash	bluestem, chalky 1
A. nodosus (Willem.) Nash	bluestem 2
A. virginicus L.	bluestem, broomsedge 1
Brachiaria humidicola (Rendle) Schw.	grass 1
Chloris petraea Swartz	chloris, stiffleaf 1
Cynodon dactylon (L.) Pers.	grass, bermuda 1,5,6
Cyperus distinctus Steud.	sedge 1
C. globulosus Aubl.	sedge 1
Digitaria decumbens Stent	grass, pangola 1,3,5
D. gazensis Rendle	grass 1
D. pentzii Stent	grass 1,2
D. sanguinalis (L.) Scop.	grass, hairy crab 1
D. setivalva Stent	grass 2
D. swazilandensis Stent	grass 2
D. valida Stent	grass 1,2
Eleusine indica (L.) Gaertin.	grass, goose 1
Eragrostis curvula (Schrad.) Nees	grass 2
Eremochloa ophiuroides (Munro) Hack.	grass, centipede 5
Eriochloa polystachya H.B.K.	grass, carib 6
Gerbera jamesoni Hook	gebera 4
Hemarthria altissima Stapf & Hubb.	grass 1
Malpighia glabra L.	cherry, Barbados 5
Panicum antidotale Rentz.	grass 2
P. coloratum L.	grass 2
P. hemitomon Schult.	maidencane 1
P. maximum Jacq.	grass, guinea 1,6
P. purpurascens Raddi	grass, para 1,6
P. repens L.	grass, torpedo 1
P. virgatum L.	grass, switch 1
Paspalum notatum Flugge	grass, bahia 1
P. plicatulum Michx.	grass 1
P. urvillei Steud.	grass, vasey 1
Pennisetum ciliare (L.) Link	grass 2
Rhynchelytrum roseum (Nees) Stapf & Hubb.	grass, natal 1
Saccharum officinarum L.	sugarcane 1
Setaria geniculata (Lam.) Beauv.	bristlegrass 1
Sorghum vulgare Pers.	sorghum 1
Sporobolus poiretii (Roem. & Schult.) Hitchc.	grass, smut 1
Stenotaphrum secundatum (Walt.) Kuntze	grass, St. Augustine 3
Zea mays L.	corn 6

TABLE 2. HEAD CAPSULE AND MESOTHORACIC WING PAD MEASUREMENTS (IN MM) OF THE NYMPHAL INSTARS OF *Prosapia bicincta* IN FLORIDA—1968.

Instar	Mean head width	Range	Mean wing pad length	Range
I	0.34	0.32-0.37		
II	0.61	0.57-0.69	0.14	0.12-0.15
III	0.98	0.94-1.02	1.31	0.29-0.35
IV	1.51	1.42-1.63	0.82	0.79-0.84
V	2.16	2.01-2.25	2.50	2.40-2.55

served both at Belle Glade and Ona. Mummified adults were found attached to blades of grass relatively high above the ground. W. G. Genung (unpublished data) found the remains of the two-lined spittlebug in the stomachs of several southern meadow larks, *Sturnella magna argulata* (Bangs). He also has observed the adults in the webs of the garden spider, *Argiope aurantia* Lucas, and the golden silk spider, *Nephila clavipes* (L.). Finally he recorded the reduviid, *Zelus bilobus* (Say), as a predator.

Many spittlebugs were encountered in light traps with mites attached to them. Individuals had up to 6 mites, attached mostly to the legs and wings. Most of the mites were *Leptus* sp. (Trombidiformes: Erythraeidae) and one *Clavidromus transvaalensis* (Nesbitt) (Mesostigmata: Phytoseiidae).[4]

LIFE CYCLE:—The length of the life cycle is influenced by environmental factors, especially temperature. At 22.2-24.4°C about 19 days are needed for the eggs to hatch. Under greenhouse conditions the nymphal period lasts about 50 days. Females can oviposit when 7 days old, giving a total of 76 days for the life cycle from egg to egg.

Depending upon temperature and precipitation, most of the overwintering eggs hatch from late March to late April. The 1st generation adults are then abundant in June. The adult population peaks again in early August to early September, and this generation deposits overwintering eggs.

LIGHT TRAPPING:—Adults, especially males, are active at night and are attracted to light traps. In 5 nights at Belle Glade, about 85% of the adults were captured within 4 hr after sunset (Fig. 1). The peak occurred about 1 hr after sunset. The activity of the females was similar to that of the males. When precipitation occurred during this period of activity, the catch was greatly reduced.

The seasonal occurrences of adults in light traps at Gainesville are shown in Fig. 2 for the years 1966-68. Adults were captured as early as May 1 and as late as December 2. Catches averaged 96% males. There were 2 peaks of abundance indicating two generations per year.

When light traps were compared at 2 heights, those with lamps centered 24 inches above the ground captured 18% more spittlebugs than 48 inch

[4] Identified by H. A. Denmark, Fla. State Dep. of Agr., Div. of Plant Industry, Gainesville.

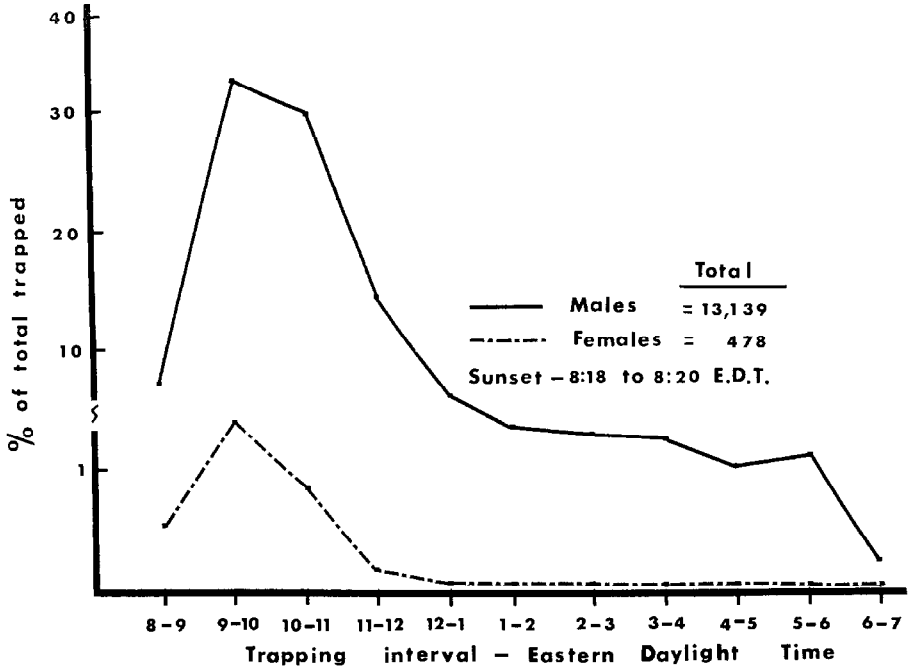

Fig. 1. Percentages of male and female *Prosapia bicincta* trapped per hour in five nights at Belle Glade, Fla.—June 1968.

high traps. Catches were about 95% males in the high traps compared to 90% males in the low traps.

NATURE OF INJURY TO PANGOLAGRASS:—Byers and Wells (1966) proved that only the adults caused injury through the injection of phytotoxic salivary substances. Age and sex were not important in the ability of the adult to produce injury (Byers and Taliaferro 1967).

P. bicincta is primarily a pest on pangolagrass, *Digitaria decumbens* Stent, in Central Florida. Field observations indicated that it is the adult that damages pangola. Large populations of nymphs went unnoticed until the adults emerged and caused injury.

Adults caged on pangolagrass caused injury symptoms within 24 hr. Symptoms first appeared on the blades immediately above the feeding site, then progressed to the next higher blade. Injury to a single blade began at the terminal end. The tip turned yellow (Plate 9K4; Maerz and Paul 1930) and this discoloration proceeded basally. Yellowing was followed by the blade turning brown (Plate 19J1) and curling. Where the stem forked above the feeding site, only one fork showed symptoms. The blades died in 1-3 days and the stem in 3-4 days.

ACKNOWLEDGEMENTS

The authors express thanks to L. A. Hetrick and D. H. Habeck for providing samples from which the 1966 and 1968 light trap data were obtained. A special thanks is extended to W. G. Genung for his contributions to this study.

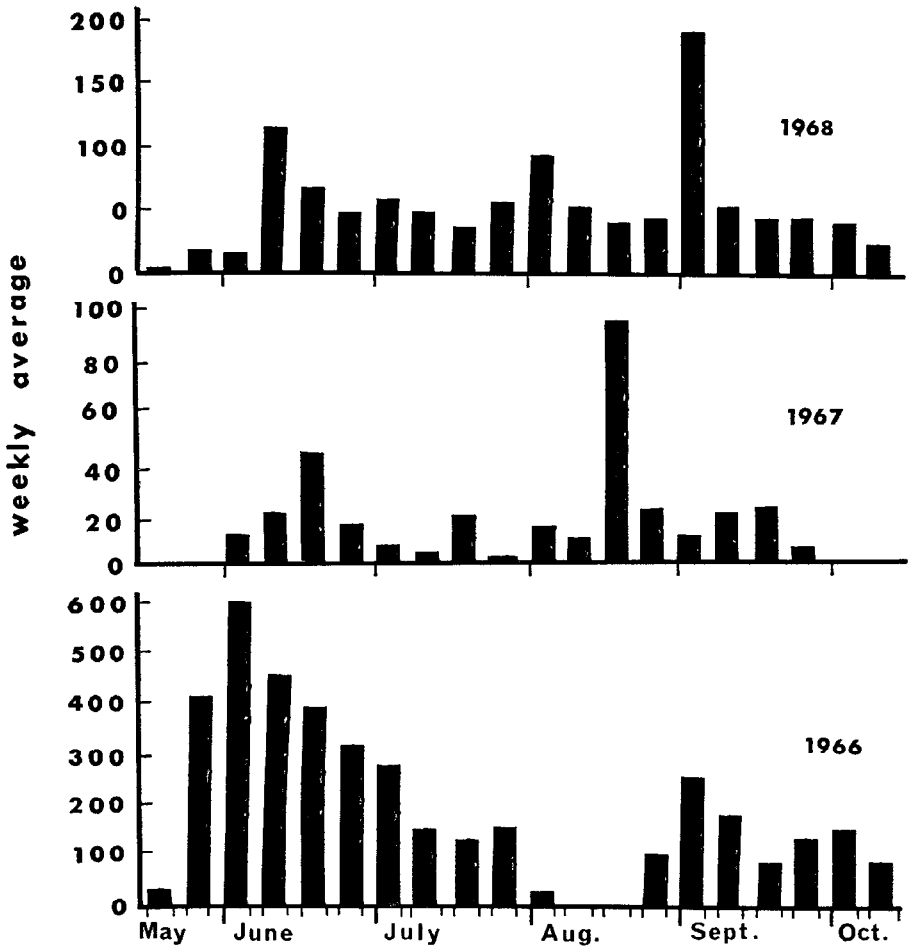

Fig. 2. Seasonal occurrence of *Prosapia bicincta* in light traps at Gainesville, Fla.

Literature Cited

Ball, E. D. 1928. Notes on the Cercopidae of America North of Mexico (Homoptera). Entomol. News 39: 47-49.

Beck, E. W. 1963. Observations on the biology and cultural-insecticidal control of *Prosapia bicincta*, a spittlebug, on Coastal bermudagrass. J. Econ. Entomol. 56: 747-52.

Byers, R. A. 1965. Biology and control of a spittlebug, *Prosapia bicincta* (Say), on Coastal bermudagrass. Univ. of Georgia Agr. Exp. Sta. Tech Bull. N.S. 42. 26p.

Byers, R. A., and C. M. Taliaferro. 1967. Effects of age on ability of the adult two-lined spittlebug, *Prosapia bicincta*, to produce phytotoxemia of Coastal bermudagrass. J. Econ. Entomol. 60: 1760-1.

Byers, R. A., and H. D. Wells. 1966. Phytotoxemia of Coastal bermudagrass caused by the two-lined spittlebug, *Prosapia bicincta* (Homoptera: Cercopidae). Ann. Entomol. Soc. Amer. 59: 1067-71.

Genung, W. G., and R. J. Allen, Jr. 1962. Survey of insects associated with agronomic introductions. Proc. Soil and Crop Sci. Soc. Fla. 22: 153-59.

Genung, W. G., W. Thames, and D. D. Questal. 1954. Coop. Econ. Insect Rep. 4(20): 400.

Hollingsworth, J. P., J. G. Hartsock, and J. M. Stanley. 1963. Electrical insect traps for survey purposes. USDA, ARS, 42-3-1. 10p.

King, E. W., C. D. Pless, and J. K. Reed. 1965. An automatic sample-changing device for light-trap collections. J. Econ. Entomol. 58: 170-2.

Maerz, A., and M. R. Paul. 1930. Dictionary of Color. McGraw-Hill Book Co., Inc., New York. 207p.

Maines. 1954. Coop. Econ. Insect Rep. 4(13): 259.

Mead, F. W. 1962. A spittlebug, *Prosapia bicincta* (Say) (Homoptera: Cercopidae). Fla. Dep. Agr. Div. Plant Industry Entomol. Circ. No. 7. 1p.

Pass, B. C., and J. K. Reed. 1965. Biology and control of the spittlebug, *Prosapia bicincta,* in Coastal bermuda grass. J. Econ. Entomol. 58: 275-8.

Washbon, E. C. 1968. The biology and control of two species of spittlebugs, genus *Prosapia,* (Homoptera: Cercopidae) in South Florida and Costa Rica. M. S. thesis, University of Florida.